Remarks

Claims 1, 7, 8, 9 and 18 have been amended and new claims 22-29 have been added to the application. Entry of these amendments is requested.

The amendments are made to more clearly distinguish the claims over prior art recently submitted by Applicants in an information disclosure statement. Independent claims 1 and 18 have been amended to indicate that each view is acquired with a pulse sequence having a readout gradient (i.e., the frequency encoding axis) directed along the same direction as table motion. New claims 22-25 have been added to more clearly recite the reconstruction of real-time monitor images during the movement of the patient through the scanner. While the monitor images depict only a small FOV as compared to the total FOV_{tot}, they do enable contrast agent to be seen as the scan is being performed so that table velocity can be adjusted to better track the peak in image enhancement provided by the contrast agent as it flows through the patient.

New claims 26-29 have been added to more clearly recite the orientation of the slab of excited magnetization. As described starting at paragraph 19 and shown in Fig. 3, in the preferred embodiment of the invention an excited slab 12 has a thickness along the z-axis which is perpendicular to the axis of subject motion (the x-axis). The thickness of this slab 12 can be limited to include only the anatomy of interest and anatomy outside the slab 12 will not be aliased into the image. By limiting the thickness of the slab 12, fewer phase encoding steps are needed in the slab-select direction (z-axis) for a given image resolution. Fewer phase encoding steps results in faster scan time, and hence increased table velocity.

The amended claims are believed to recite patentable subject matter and allowance of the same is requested. Applicants enclose a copy of an article which they published on the subject of the invention in this application. This article is not prior art, but it cites all the references known to applicants at the time. It is believed

that the most material references are already of record, but if the examiner would like a copy of any of these references, Applicants can provide them.

The Commissioner is authorized to charge any fees under 37 CRF § 1.17 that may be due on this application to Deposit Account 17-0055. The Commissioner is also authorized to treat this amendment and any future reply in this matter requiring a petition for an extension of time as incorporating a petition for extension of time for the appropriate length of time as provided by 37 CFR § 136(a)(3).

Respectfully submitted,

DAVID G. KRUGER, ET AL

Date: October 8, 2002

Barry E. Sammons
Quarles & Brady, LLP
Reg. No. 25,608
Attorney for Applicant
411 East Wisconsin Avenue
Milwaukee WI 53202
414/277-5000

Marked Up Version Showing Changes

Hereinafter, added text is shown as underlined while deleted text is shown in square brackets.

Amended Claims:

1. (Amended) In a magnetic resonance imaging (MRI) system having a defined field of view (FOV), a method for producing an image of a subject over an extended field of view (FOV_{tot}) which is larger than the FOV, the steps comprising:

a) moving the subject through the MRI system such that the extended field of view (FOV_{tot}) passes through the defined field of view (FOV);

b) continuously acquire NMR data from the subject as it is moved through the FOV by repeatedly performing an imaging pulse sequence which acquires NMR data comprising a view of the subject <u>using a readout gradient directed along the direction of subject movement</u>;

c) adjusting each view acquired in step b) using subject position information;

d) storing each adjusted view in a data matrix; and

e) reconstructing an image using the data matrix.

7. (Amended) The method as recited in claim 1 in which step c) includes adjusting the location in the data matrix in which the view is stored in step d) <u>along the direction of subject movement</u>.

9. (Amended) The method as recited in claim 2 in which step c) includes adjusting the location in the data matrix in which the view is stored in step d) <u>along the direction of subject movement</u> as a function of the table location at the time the view is acquired in step b).

18. (Amended) In a magnetic resonance imaging (MRI) system, the improvement comprising:

a) a table for supporting a subject and for moving the subject through a defined field of view (FOV) of the MRI system;

b) a pulse generator for operating the MRI system under the direction of a pulse sequence to continuously acquire a series of NMR data views of the subject as the subject is moved through the FOV using a readout gradient directed along the direction of table movement;

c) means for adjusting each acquired view as a function of subject location at the time the view is acquired with respect to a reference subject location;

d) a memory for storing the adjusted views as a data matrix; and

e) means for reconstructing an image from data in the data matrix which has a field of view in the direction of table motion which is larger than the defined FOV.

22. In a magnetic resonance imaging (MRI) system having a defined field of view (FOV), a method for producing an image of a subject over an extended field of view (FOV_{tot}) which is larger than the FOV, the steps comprising:

a) moving the subject through the MRI system such that the extended field of view (FOV_{tot}) passes through the defined field of view (FOV);

b) continuously acquire NMR data from the subject as it is moved through the FOV by repeatedly performing an imaging pulse sequence which acquires NMR data comprising a view of the subject;

c) adjusting each view acquired in step b) using subject position information;

d) storing each view in a data matrix;

e) reconstructing monitor images as step b) is performed using adjusted data stored in the data matrix, each reconstructed monitor image covering substantially less than the extended field of view (FOV_{tot}); and

f) reconstructing an image over the extended field of view (FOV_{tot}) using the data matrix.

23. The method as recited in claim 22 in which the MRI system has a table, and step a) is performed by:

i) placing the subject on the table; and

ii) moving the table.

24. The method as recited in claim 23 which includes:

injecting the subject with a contrast agent;

and in which the table is moved at a velocity which tracks the contrast agent as it moves through the extended field of view (FOV_{tot}).

25. The method as recited in claim 24 in which table motion velocity is adjusted during the performance of steps a) and b) to better track the contrast agent as determined by the reconstructed monitor images.

26. A method for producing an image of a subject with a magnetic resonance imaging (MRI) system, the steps comprising:

a) moving the subject through a defined field of view (F)V) of the MRI system along a motion axis;

b) continuously acquiring NMR data from the subject as the subject is moved along said motion axis through the FOV, the NMR data being acquired by:

i) producing an RF excitation pulse in the presence of a slab select gradient pulse to produce transverse magnetization in a three-dimensional volume having a thickness along a slab select gradient axis which is perpendicular to the motion axis;

ii) producing a phase encoding gradient pulse;

iii) acquiring an NMR signal in the presence of a readout gradient field directed along the axis of motion; and

iv) repeating steps i), ii) and iii) and cycling the phase encoding gradient pulse through a set of discrete values to acquire k-space data from the excited three-dimensional volume;

c) storing the acquired k-space data in a data matrix;

d) adjusting the data stored in the data matrix to offset the effect of table motion thereon; and

e) reconstructing an image from the adjusted data stored in the data matrix.

27. The method as recited in claim 26 in which step d) includes:

Fourier transforming data stored in the data matrix along the motion axis; and

shifting the storage location of the Fourier transformed data in the data matrix along the motion axis.

28. The method as recited in claim 26 which includes:

recording the location of the subject as each NMR signal is acquired; and

phase shifting the k-space data corresponding to each NMR signal by an amount determined by the subject location as the NMR signal was acquired.

29. The method as recited in claim 28 which includes:

Fourier transforming the k-space data corresponding to each NMR signal; and

shifting the storage location in the data matrix along the axis of motion of each Fourier transformed NMR signal by an amount determined by the subject location as the NMR signal was acquired.